

ABUNDANCE AND SEASONAL ACTIVITY OF EUCINETOIDEA (COLEOPTERA) IN A RASPBERRY PLANTATION AND ADJACENT SITES IN SOUTHERN QUÉBEC (CANADA)¹

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ABSTRACT: In a raspberry plantation and adjacent sites in southern Québec, we collected adult Eucinetoidae with unbaited pitfall traps and flight interception traps, from early May through late October in 1987, 1988 and 1989. A total of 350 Clambidae (three species), 33 Eucinetidae (four species) and 48 Scirtidae (five species) were collected. The most common species at the soil surface of the raspberry plantation was *Clambus armadillo*. The most abundant species in flight traps were *Clambus howdeni*, *C. armadillo*, *Eucinetus testaceus* and *Cyphon variabilis*. Adults of *C. armadillo*, *C. howdeni* and *C. variabilis* were active mainly in spring and/or early summer and probably overwintered as adults; whereas *Eucinetus testaceus* flew mainly in August and probably overwintered as larvae.

Although world production of raspberries has increased about 5% each year over the past decade (Pritts 1991), little is known on variations in beetle communities associated with raspberry (*Rubus idaeus* L.) plantations, particularly for mycophagous insects. These ecosystems appear as rather stable sites because plants of many raspberry cultivars, with perennial root systems and biennial canes, may be kept over about ten years. Over a three-year period (1987-1989), we collected nearly 60,000 beetles in a raspberry plantation and adjacent sites in southern Québec. We have already presented results for the Nitidulidae and Elateroidea (Levesque and Levesque 1992, 1993). We now present results on the abundance and seasonal activity of adult Clambidae, Eucinetidae and Scirtidae (= Helodidae). These three families of Eucinetoidae are of no known economic importance and little is known of their life history, ecology and behavior. Wheeler and Hoebeke (1984) reviewed published records of hosts and microhabitats of species of Clambidae and Eucinetidae, families considered mainly mycophagous. However, no scirtids are known to be associated with fungi (Wheeler and Hoebeke 1984). All known larvae of Scirtidae are aquatic, phytophagous or detritivorous, and are common in small lentic habitats and shallow areas of peatland pools and marches. Scirtid adults are terrestrial and common along the margins of pools or on emergent plants (Larson 1987).

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MATERIALS AND METHODS

Beetles were collected from early May through late October on a monocultural raspberry farm at Johnville, near Sherbrooke, in southern Québec. We sampled from the Boyne cultivar in this conventionally cultivated plantation (about 7 ha, on sandy soil).

Ground surface-active beetles were caught with pitfall traps at the following sites: 1) a raspberry row planted in 1978 (**old plants**), 2) a raspberry row planted in 1985 (**young plants**), 3) a woods-field boundary (**boundary**), and 4) an adjacent wooded site dominated by eastern white pine, *Pinus strobus* L. (**pine woods**). Pitfall traps consisted of glass jam jars (450 ml, 6.5 cm diameter at the top) partially filled with 100 ml of 4% formalin. Traps were inserted into the soil beneath the canopy as close to the cane of raspberry plants as possible at the first two sites. At each site, 20 traps were set in a row (5 m apart) and were emptied weekly.

In addition, we studied beetles flying close to the ground with flight interception traps at four sites: 1) an open site near the center of the plantation (**A**), about 20 m from old plants; 2) an open site near a pond (**B**), about 5 m from young raspberry plants; 3) a woods-field boundary (**C**); and 4) a pine woods (**D**). These traps were not located between rows of raspberry plants because of grower's activities and public access during harvest. Flight traps were modified from the large-area "window" trap design promoted by Peck and Davies (1980). Each consisted of a gray 1.5 mm mesh window screen (1.22 m height, 1.52 m width, about 1.85 m² of surface) fastened to a wooden frame. The frame itself was suspended by two lateral triangular wooden supports (1.83 m at the base, 1.25 m height), 2-4 cm over a set of two galvanized metal pans (25 by 61 cm at the top, 7.5 cm deep) which were placed directly on the ground. The insects were caught in the pans partially filled with 2% formalin into which a few drops of detergent were added. We installed one flight trap at each site; however, the trap was operated in 1988 and 1989 only in the pine woods (**D**). Samples were collected twice a week and the formalin solution was replaced at each collection; the trap counts from individual sampling periods were combined on a weekly basis.

Levesque and Levesque (1992) presented more detailed information about the sampling methods and study sites, including a sketch-map of the raspberry farm.

RESULTS AND DISCUSSION

Abundance of Eucinetoidae Catches. We collected a total of 350 Clambidae (three species), 33 Eucinetidae (four species) and 48 Scirtidae

(five species). Voucher specimens of some species are deposited in the Canadian National Collection (Ottawa).

Pitfall trapping resulted in the collection of 262 Clambidae (two species), 3 Eucinetidae (two species) and 1 Scirtidae (Table 1). Almost all eucinetoids represented *Clambus armadillo* (DeGeer) (97% of catches). Adults of this species were collected in similar numbers in rows of old and young raspberry plants; the explanation of this result and possible association of these adults with fungi on *R. idaeus* are unknown. *Clambus armadillo* was also caught in large numbers at the ground surface of a wet meadow in southern Québec on clay soil (Levesque and Levesque 1987).

Table 1. Total catches of Eucinetoidae species in pitfall traps (1987-1989) at Johnville, Québec.

Family and species	Old plants	Young plants	Boundary	Pine woods	Total
Clambidae					
<i>Clambus armadillo</i> (DeGeer)	131	122	5	—	258
<i>Clambus howdeni</i> Endrödy-Younga	2	—	1	1	4
Eucinetidae					
<i>Eucinetus morio</i> LeC.	—	—	1	—	1
<i>Eucinetus oviformis</i> LeC.	—	—	2	—	2
Scirtidae					
<i>Cyphon variabilis</i> (Thunberg)	—	1	—	—	1

Total catches of eucinetoids in flight traps comprised 88 Clambidae (three species), 30 Eucinetidae (four species) and 47 Scirtidae (five species) (Table 2); all the species monitored at Johnville were collected in flight traps.

Adults of *Clambus howdeni* Endrödy-Younga flew chiefly at the woods-field boundary and in the pine woods, while *Clambus armadillo* was mainly captured in the three flight traps (A, B and C) near the raspberry plants (Table 2). *Eucinetus testaceus* LeC. was the most abundant eucinetid species and flew chiefly in the pine woods (Table 2). In two mixed deciduous-coniferous forest sites in New Hampshire, Chandler (1991) observed the flight activity of *Clambus howdeni* and four species of *Eucinetus* (chiefly *E. morio* LeC.). *Eucinetus morio* was a slime-mold associate, whereas *C. howdeni* and the other three species of *Eucinetus* (*E. oviformis* LeC., *E. punctulatus* LeC., and *E. testaceus*) were associated with Basidiomycete fruiting bodies (Chandler 1991).

Table 2. Total catches of Eucinetoidae species in flight traps (1987-1989) at Johnville, Québec.

Family and species	Open site near center (A)	Open site near pond (B)	Boundary (C)	Pine woods ^a (D)	Total
Clambidae					
<i>Clambus armadillo</i> (DeGeer)	12	10	13	1	36
<i>Clambus gibbulus</i> (LeC.)	—	—	2	—	2
<i>Clambus howdeni</i> Endrödy-Younga	2	5	22	21	50
Eucinetidae					
<i>Eucinetus morio</i> LeC.	—	—	1	3	4
<i>Eucinetus oviformis</i> LeC.	—	—	1	1	2
<i>Eucinetus testaceus</i> LeC.	1	—	3	19	23
<i>Eucinetus</i> sp.	—	1	—	—	1
Scirtidae					
<i>Cyphon obscurus</i> (Guérin)	1	4	3	—	8
<i>Cyphon</i> prob. <i>ruficollis</i> (Say)	1	—	—	—	1
<i>Cyphon pusillus</i> (LeC.)	1	—	—	—	1
<i>Cyphon variabilis</i> (Thunberg)	4	18	8	3	33
<i>Prionocyphon limbatus</i> LeC.	—	4	—	—	4

^a not sampled in 1987.

The five species of Scirtidae flew in open sites (A and B) and the boundary site (C). The most abundant species was *Cyphon variabilis* (Thunberg), apparently eurytopic, but mainly collected at the open site B which was near a pond (Table 2). Nilsson (1980) studied the flight activity of nine scirtid species in the vicinity of a river in northern Sweden, and found *Cyphon variabilis* to be one of the three most abundant species.

Seasonal Abundance of Four Species of Eucinetoidae. Adults of *Clambus armadillo* were caught by pitfall traps from May through October during the three-year study, mainly in May and the first half of June (Fig. 1). They flew from May until early September, but chiefly in May. In a wet meadow of southern Québec, the soil-surface activity was observed in late spring and summer, mainly in June and July (Levesque and Levesque 1987).

We observed the flight of *Clambus howdeni* only in May, June and July during the three-year study (Fig. 2). In New Hampshire, flight occurred from May through July, but a few adults were also collected in late summer (Chandler 1991).

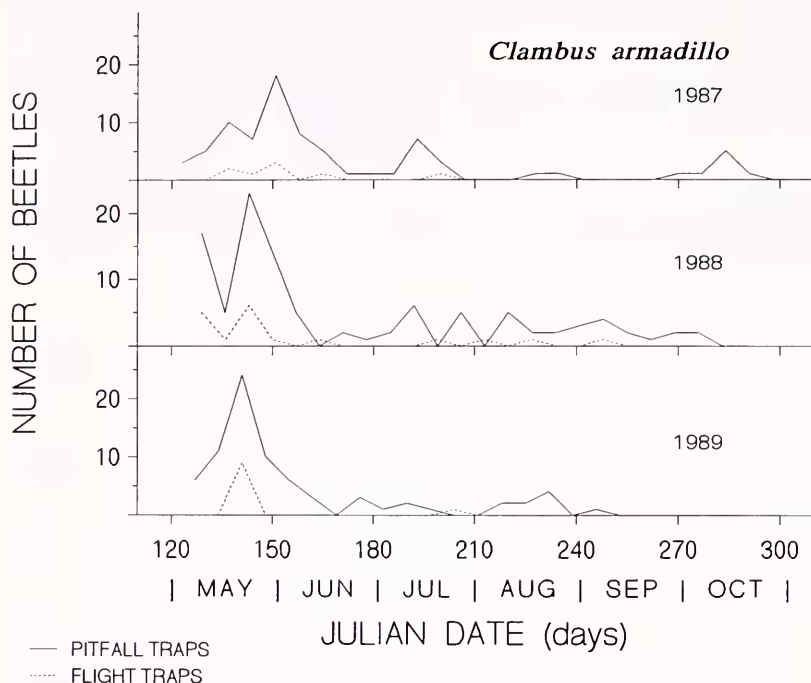


Fig. 1. Seasonal abundance of *Clambus armadillo* in pitfall and flight traps at Johnville, Québec.

Adults of *Cyphon variabilis* flew from May through October, but mainly in May (Fig. 2). In northern Sweden, Nilsson (1980) observed two flight periods, the first from mid-May until early July, the second in late summer and autumn; the peak of captures occurred in June. According to Larson (1987), adults of this species overwinter and reproduce in spring and early summer.

Adults of *Eucinetus testaceus* flew from June through September during the three-year study, and mainly in August (Fig. 2). We caught a teneral adult on June 25, 1989. In New Hampshire, adults of *E. morio* flew mainly in spring and early summer, and one adult was also caught in October (Chandler 1991). In the Finger Lakes region of New York, a breeding population (adults and larvae) of *E. oviformis* was found in late summer, in association with a wood-rotting fungus; in addition, mature larvae and some adults of this species were still present as late as October 18 (Hoebeke *et al.* 1987).

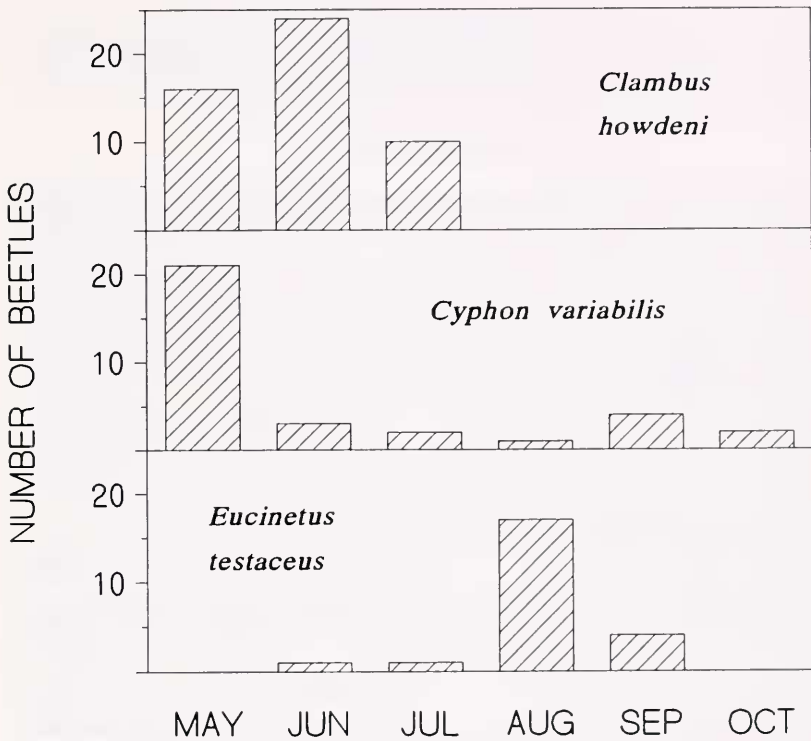


Fig. 2. Seasonal abundance of *Clambus howdeni*, *Cyphon variabilis* and *Eucinetus testaceus*, in flight traps (1987-1989) at Johnville, Québec.

Two life-history patterns are observed among northern European species of Scirtidae: 1) larvae overwinter and reproduction occurs in midsummer, and 2) adults overwinter and reproduce in spring and early summer (Larson 1987). According to Nilsson (1980), the seasonal flight pattern of Scirtidae coincide with these two life-history patterns. If such is the case in other eucinetoids, we suspect that *Clambus armadillo* and *C. howdeni* overwinter as adults, whereas *Eucinetus testaceus* overwinters as larvae.

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